Plant Science into Practice

NIAB TAG

Reconnecting the UK crop development pipeline – a NIAB perspective

Meeting the challenge

- Boosting agricultural productivity, conserving resources and coping with climate change
- Knowledge exchange is key for industry to respond to challenges
- The status of agricultural research in the UK
- The application of science and translation to practice on the ground, where there are widely considered to be serious fractures in the pipeline

Fracture: biotech and beyond

- In the 90's, public funding for crop science declined as incentives appeared for private sector investment
- In EU and elsewhere, there is a lack of political support for GM evaluation and commercial introduction
- R&D strong; but exploitation (pull-through) migrates to more amenable countries and crops
  - Maize soybean rice cotton, US
- A major tool is not available to breeders: KT is limited
- Science based regulation is required

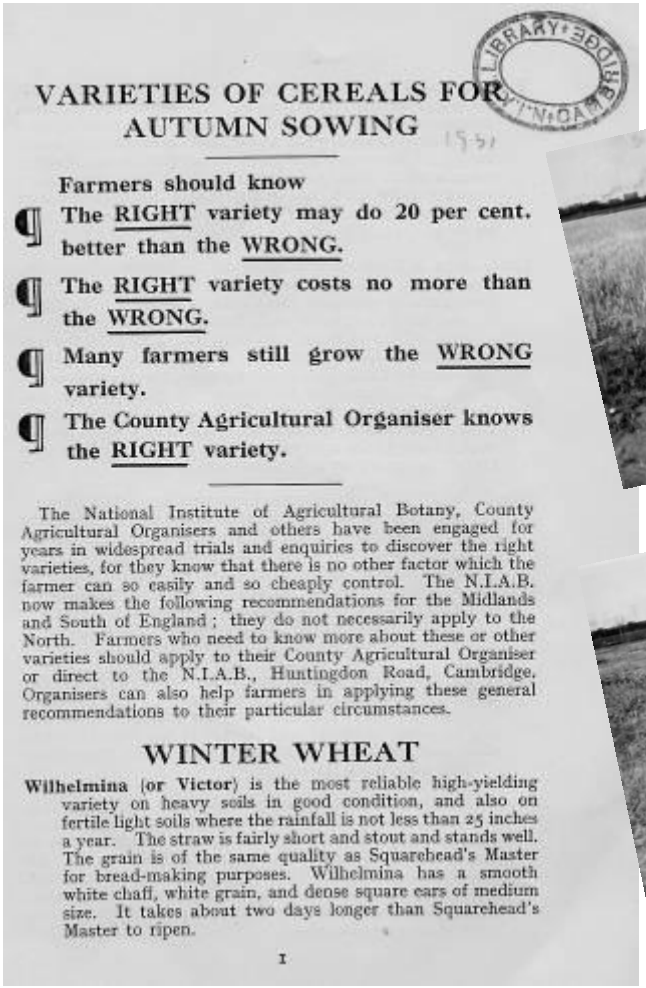
Meeting the challenges?

- 13 year stagnation in EU system due entirely to politics- rigorous approval mechanism not allowed to function
- Commission have proposed greater autonomy at national level to get it functioning
- UK science at all levels must act together to respond
- NIAB is forging partnerships and interacting at every stage
- Branding must not get in the way of delivery!

‘Better seeds…better crops’

- Food crisis after WW1
- NIAB established by charitable donations for ‘the improvement of crops .. with higher….. genetic quality’
- **Barriers to plant breeding, or to access for growers to improved varieties, were recognised barriers to enhanced food production**

Plant Science into Practice



VARIETIES OF CEREALS FOR AUTUMN SOWING

Farmers should know

¶ The RIGHT variety may do 20 per cent. better than the WRONG.

¶ The RIGHT variety costs no more than the WRONG.

¶ Many farmers still grow the WRONG variety.

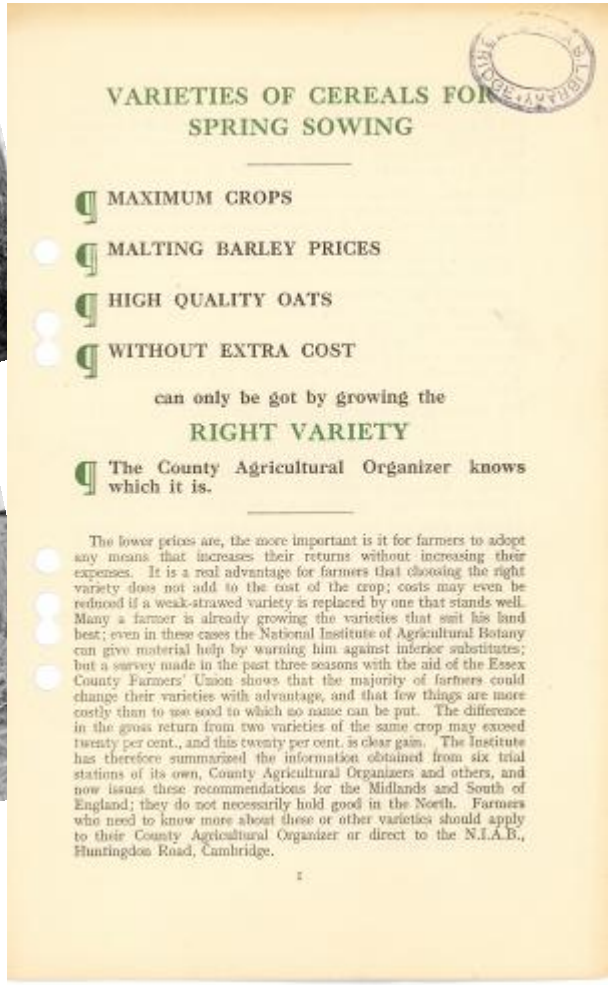
¶ The County Agricultural Organiser knows the RIGHT variety.

The National Institute of Agricultural Botany, County Agricultural Organisers and others have been engaged for years in widespread trials and enquiries to discover the right varieties, for they know that there is no other factor which the farmer can so easily and so cheaply control. The N.I.A.B. now makes the following recommendations for the Midlands and South of England; they do not necessarily apply to the North. Farmers who need to know more about these or other varieties should apply to their County Agricultural Organiser or direct to the N.I.A.B., Huntingdon Road, Cambridge. Organisers can also help farmers in applying these general recommendations to their particular circumstances.

WINTER WHEAT

Wilhelmina (or Victor) is the most reliable high-yielding variety on heavy soils in good condition, and also on fertile light soils where the rainfall is not less than 25 inches a year. The straw is fairly short and stout and stands well. The grain is of the same quality as Squarehead's Master for bread-making purposes. Wilhelmina has a smooth white chaff, white grain, and dense square ears of medium size. It takes about two days longer than Squarehead's Master to ripen.

1



VARIETIES OF CEREALS FOR SPRING SOWING

¶ MAXIMUM CROPS

¶ MALTING BARLEY PRICES

¶ HIGH QUALITY OATS

¶ WITHOUT EXTRA COST

can only be got by growing the

RIGHT VARIETY

¶ The County Agricultural Organizer knows which it is.

The lower prices are, the more important is it for farmers to adopt any means that increases their returns without increasing their expenses. It is a real advantage for farmers that choosing the right variety does not add to the cost of the crop; costs may even be reduced if a weak-strawed variety is replaced by one that stands well. Many a farmer is already growing the varieties that suit his land best; even in these cases the National Institute of Agricultural Botany can give material help by warning him against inferior substitutes; but a survey made in the past three seasons with the aid of the Essex County Farmers' Union shows that the majority of farmers could change their varieties with advantage, and that few things are more costly than to use seed to which no name can be put. The difference in the gross return from two varieties of the same crop may exceed twenty per cent., and this twenty per cent. is clear gain. The Institute has therefore summarized the information obtained from six trial stations of its own, County Agricultural Organizers and others, and now issues these recommendations for the Midlands and South of England; they do not necessarily hold good in the North. Farmers who need to know more about these or other varieties should apply to their County Agricultural Organizer or direct to the N.I.A.B., Huntingdon Road, Cambridge.

1

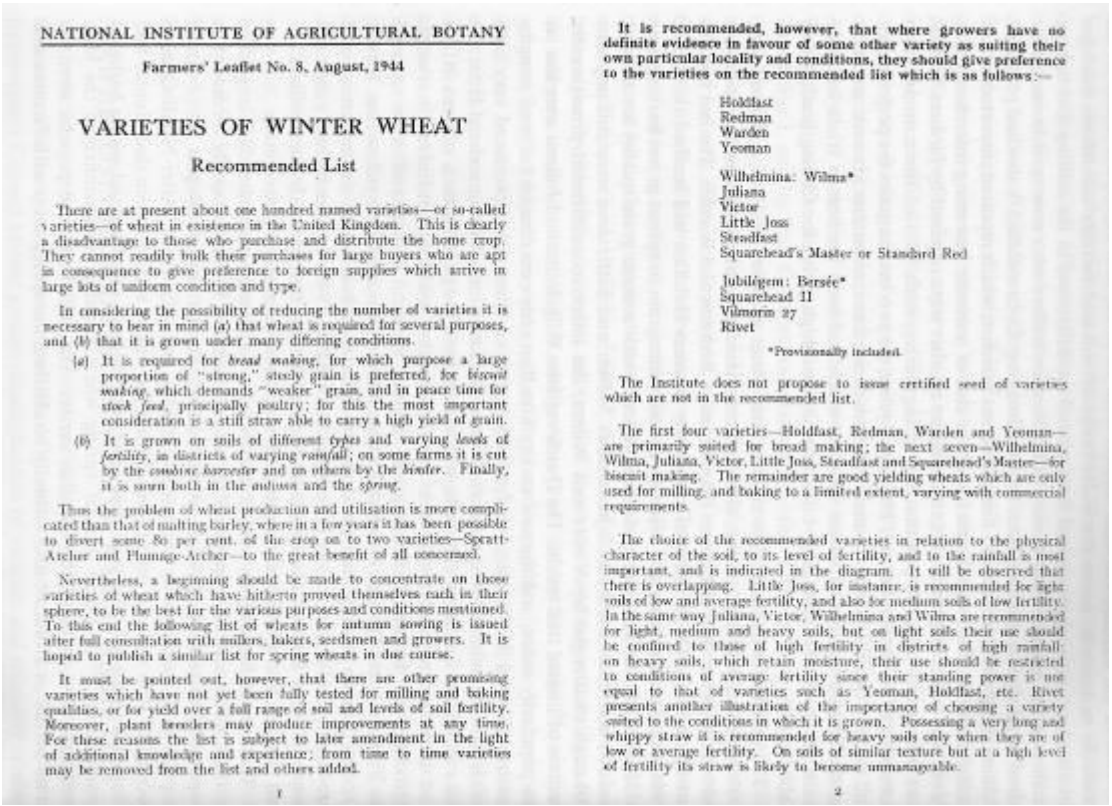
1931 Farmers leaflet

1932 Farmers leaflet

The First Farmers Leaflets

When WW2 came, supplies of quality seed were given priority and NIAB began to produce Recommended Lists of varieties

Lessons learnt



NATIONAL INSTITUTE OF AGRICULTURAL BOTANY

Farmers' Leaflet No. 8, August, 1944

VARIETIES OF WINTER WHEAT

Recommended List

There are at present about one hundred named varieties—or so-called varieties—of wheat in existence in the United Kingdom. This is clearly a disadvantage to those who purchase and distribute the home crop. They cannot readily bulk their purchases for large buyers who are apt in consequence to give preference to foreign supplies which arrive in large lots of uniform condition and type.

In considering the possibility of reducing the number of varieties it is necessary to bear in mind (*a*) that wheat is required for several purposes, and (*b*) that it is grown under many differing conditions.

(*a*) It is required for *bread making*, for which purpose a large proportion of "strong," steely grain is preferred, for *biscuit making*, which demands "weaker" grain, and in peace time for *stock feed*, principally poultry; for this the most important consideration is a stiff straw able to carry a high yield of grain.

(*b*) It is grown on soils of different *types* and varying *levels* of *fertility*, in districts of varying *rainfall*; on some farms it is cut by the *combine harvester* and on others by the *binder*. Finally, it is sown both in the *autumn* and the *spring*.

Thus the problem of wheat production and utilisation is more complicated than that of malting barley, where in a few years it has been possible to divert some 80 per cent. of the crop on to two varieties—Spratt-Archer and Plumage-Archer—to the great benefit of all concerned.

Nevertheless, a beginning should be made to concentrate on those varieties of wheat which have hitherto proved themselves each in their sphere, to be the best for the various purposes and conditions mentioned. To this end the following list of wheats for autumn sowing is issued after full consultation with millers, bakers, seedsmen and growers. It is hoped to publish a similar list for spring wheats in due course.

It must be pointed out, however, that there are other promising varieties which have not yet been fully tested for milling and baking qualities, or for yield over a full range of soil and levels of soil fertility. Moreover, plant breeders may produce improvements at any time. For these reasons the list is subject to later amendment in the light of additional knowledge and experience; from time to time varieties may be removed from the list and others added.

1

It is recommended, however, that where growers have no definite evidence in favour of some other variety as suiting their own particular locality and conditions, they should give preference to the varieties on the recommended list which is as follows:—

Holdfast
Redman
Warden
Yeoman

Wilhelmina: Wilma*
Juliana
Victor
Little Joss
Steadfast
Squarehead's Master or Standard Red

Jubilégem: Bersée*
Squarehead II
Vilmorin 27
Rivet

*Provisionally included.

The Institute does not propose to issue certified seed of varieties which are not in the recommended list.

The first four varieties—Holdfast, Redman, Warden and Yeoman—are primarily suited for bread making; the next seven—Wilhelmina, Wilma, Juliana, Victor, Little Joss, Steadfast and Squarehead's Master—for biscuit making. The remainder are good yielding wheats which are only used for milling, and baking to a limited extent, varying with commercial requirements.

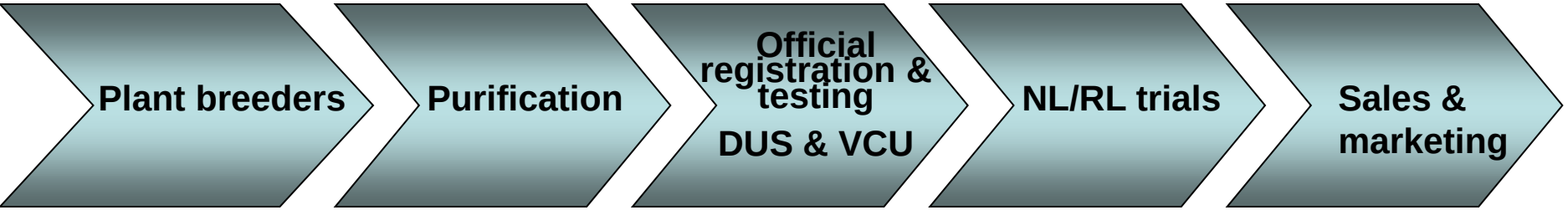
The choice of the recommended varieties in relation to the physical character of the soil, to its level of fertility, and to the rainfall is most important, and is indicated in the diagram. It will be observed that there is overlapping. Little Joss, for instance, is recommended for light soils of low and average fertility, and also for medium soils of low fertility. In the same way Juliana, Victor, Wilhelmina and Wilma are recommended for light, medium and heavy soils, but on light soils their use should be confined to those of high fertility in districts of high rainfall: on heavy soils, which retain moisture, their use should be restricted to conditions of average fertility since their standing power is not equal to that of varieties such as Yeoman, Holdfast, etc. Rivet presents another illustration of the importance of choosing a variety suited to the conditions in which it is grown. Possessing a very long and whippy straw it is recommended for heavy soils only when they are of low or average fertility. On soils of similar texture but at a high level of fertility its straw is likely to become unmanageable.

2

A regulatory framework to support innovation

- In 1964 the UK signed the UPOV convention, establishing Plant Breeders Rights (PBR).
- MAFF commissioned NIAB to test varieties for DUS and conduct statutory trials. VCU was added in 1973.
- NIAB still carries out variety evaluation, on behalf of FERA and also to support the Levy Board funded Recommended Lists.

Gateway to New Market-ready Products



"Core NIAB"

Statutory testing & contract research to DEFRA, BSPB, Levy Boards & CEL together with services to farmers & growers

Reconnecting the pipeline

- After decades of chronic under-investment in UK applied and translational agricultural research…NIAB Trust intervenes…

- Development of genetic research & pre-breeding capabilities 2005 (synthetic wheat, flowering time, transgenic capability)

Wheat a classic allo-hexaploid

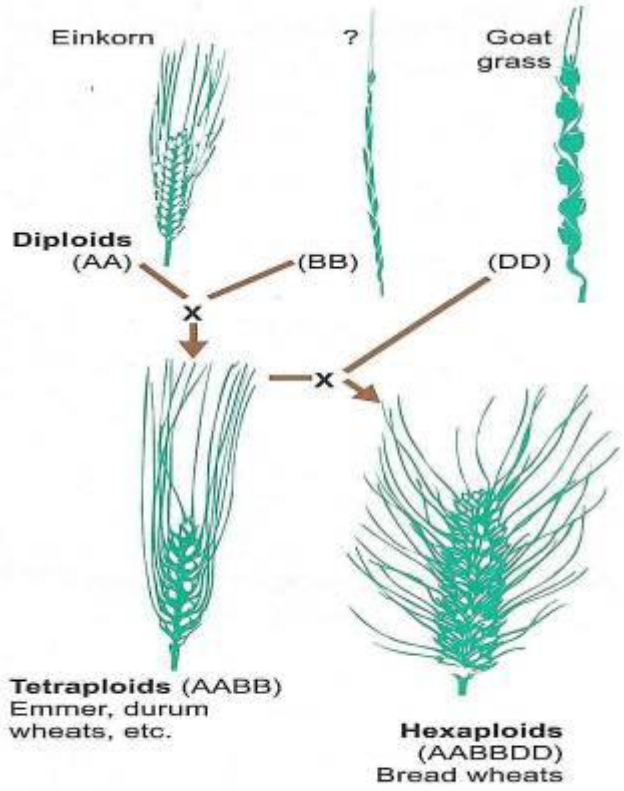
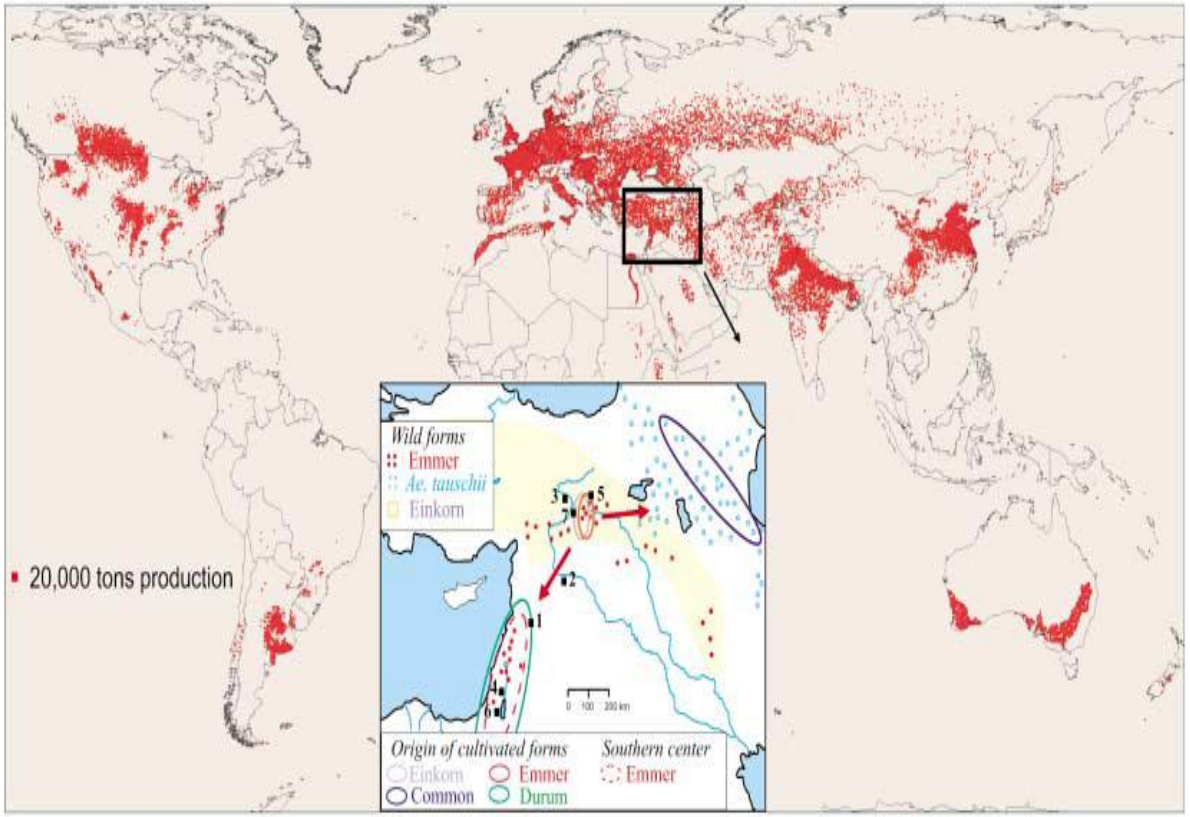
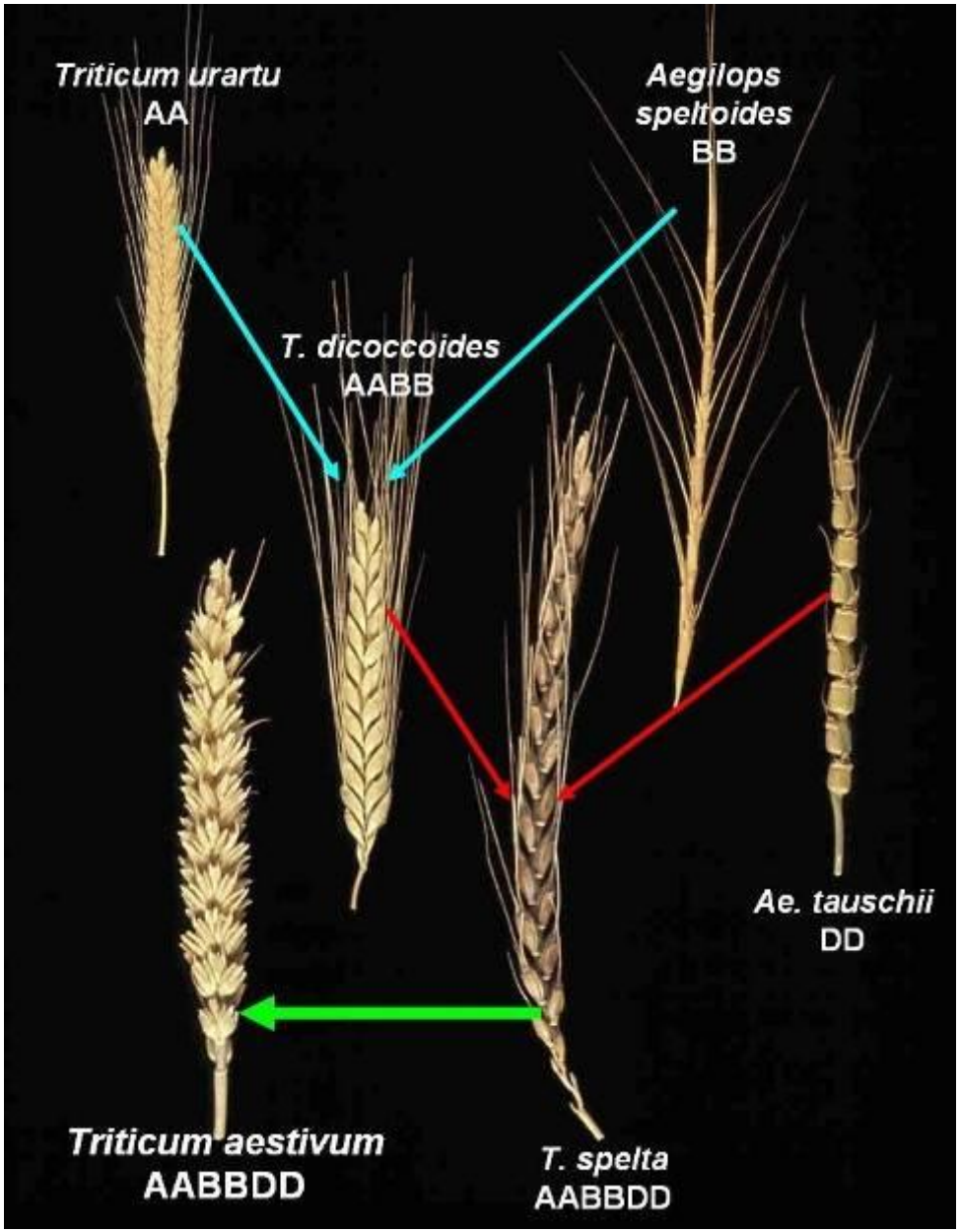


Figure 1. Origin of cultivated wheat types.
Source: Hancock (1994).



Science *Vol 316, 1862-1866*

Plant Science into Practice



Funded by NIAB Trust, BBSRC, HGCA and commercial breeders

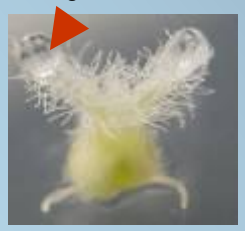
4 Examples

Wheat Ergot

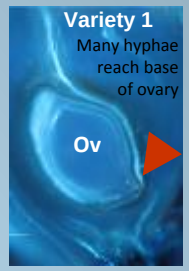
Tracing useful differences in ergot formation observed between elite varieties to precise tissue responses

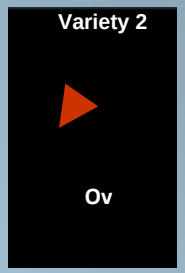
1. Extract Wheat Flower

2. Ergot inoculation



3. Compare infection progress using microscopy





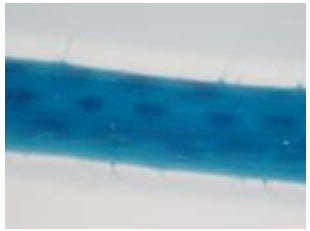
Wheat Yellow Rust

Two novel loci controlling resistance have been identified and durable resistance QTL are currently under study

Working with JIC, RRes, Universities to access novel traits for pre-breeding

The NIAB wheat TRANSFORMATION PLATFORM

- Highly efficient (20% with UK adapted genotypes) Agrobacterium-mediated system
- Seed Inoculation Method (SIM) used under licence from Biogemma SA
- Sole holders of licence from Japan Tobacco to provide commercial material within Europe



Funded by the NIAB Trust

CURRENT AREAS OF INTEREST

- Low phytate wheat
- Grain yield
- Nitrogen mobilisation
- Disease resistance
- Root morphology
- Starch and protein modification
- PHS/HFN

Reconnecting the pipeline

- After three decades of chronic under-investment in UK applied and translational agricultural research…NIAB Trust intervenes
- Development of genetic research & pre-breeding capabilities 2005 (synthetic wheat, flowering time, transgenic capability)
- Integration of TAG 2009 to extend NIAB's coverage / capabilities in applied agronomy research and knowledge transfer onto farm

TAG
THE ARABLE GROUP

Independent Research.
Impartial Advice

Recent History

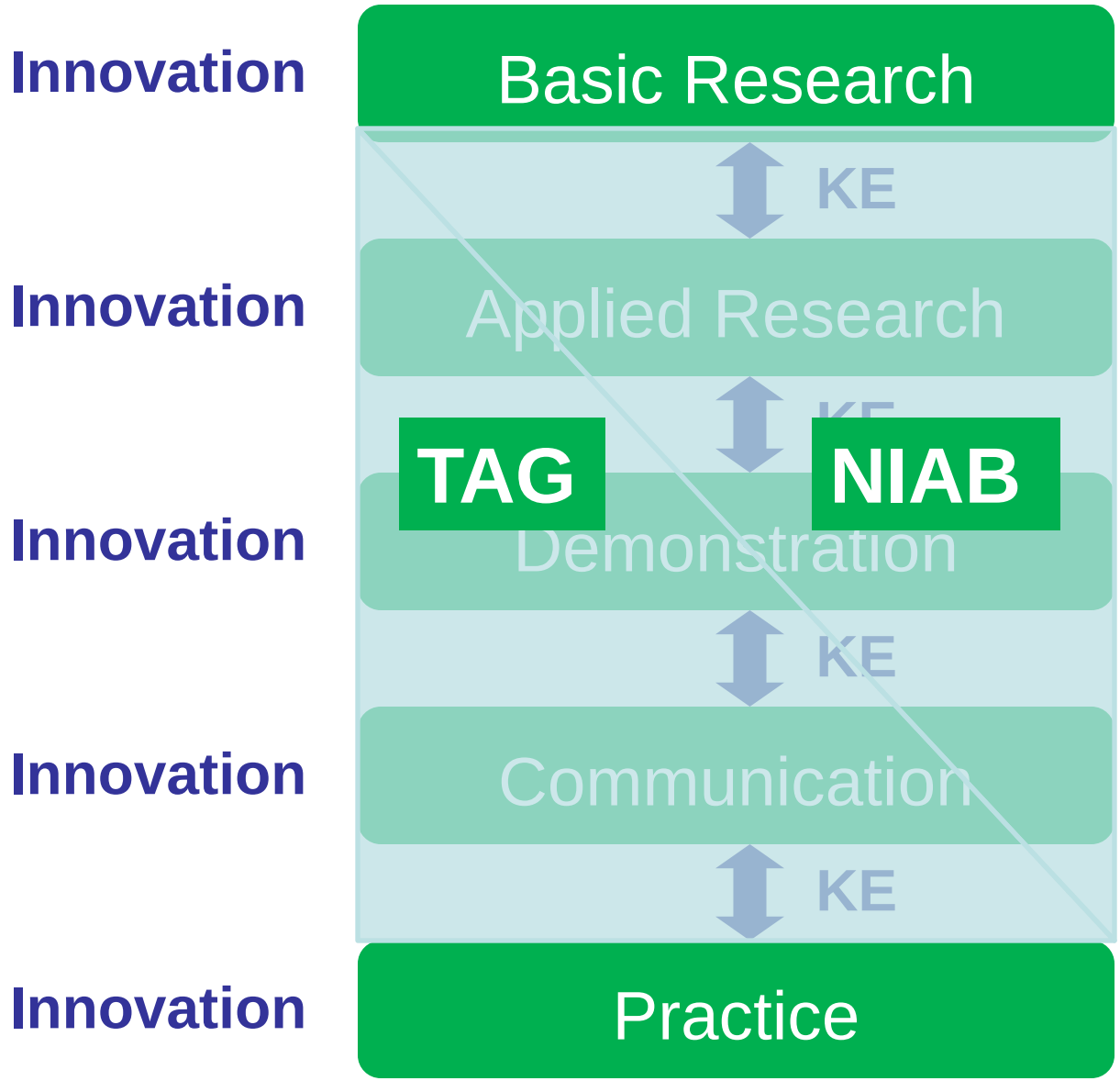
TAG acquires Silsoe Spray Applications Unit

TAG acquires ADAS consultancy

Arable Research Centre + Morley Research = The Arable Group

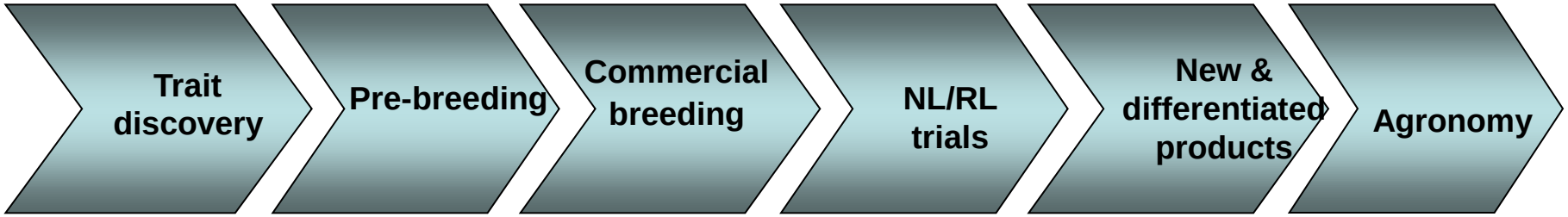
2003 2004 2005 2006 2007

Plant Science into Practice



Completing the chain

Transferring knowledge to industry



genetic research at NIAB

core NIAB

TAG

Delivery into Industry

- Expertise and involvement along the full length of the chain
- Interacting and forming partnerships at all levels
- Uniquely capable in a single organisation of putting genetics and plant variety development into a practical agronomic context

Not-for-profit

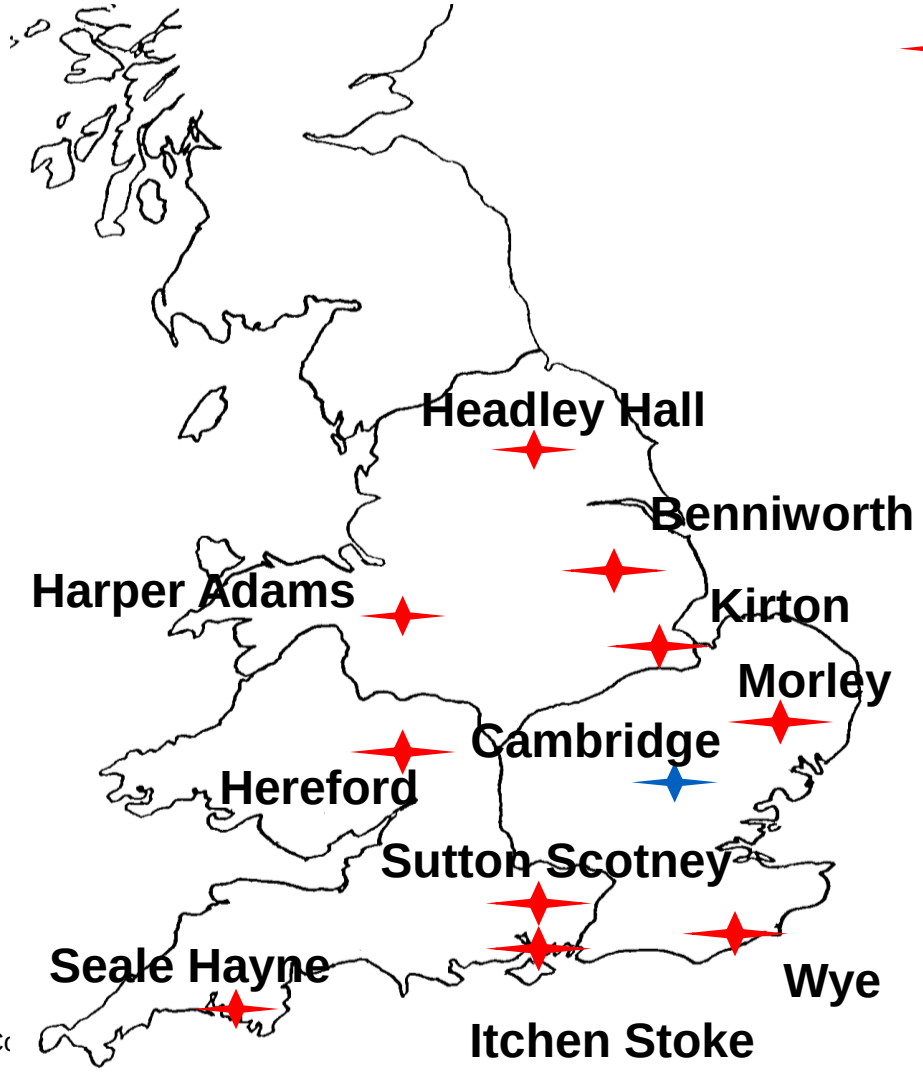
Our charitable objectives require that we:

- Engage in agricultural research
- Disseminate knowledge
- Promote this research and knowledge for public benefit
- Provide access to training

Capabilities

- At Cambridge: site development to provide fit-for-purpose glasshouses, growth rooms and laboratories
- Strong, well-resourced regional network: over 70,000 field plots last year (26,000 cereals) and 100+ farmer meetings
- 3500 members,– by far the biggest independent influencer (25%+ of UK arable acreage)
- Staff of c. 220: majority working in contract research and services
- Turnover of £11 million per annum: all income derived from competitively won contracts
- Technical information and training in the United Kingdom and overseas (c. 650 trainees pa)

Operations team – skills and capacity



Staffed regional centres

Operate on “home-farms” and off-centre sites within 30 mile radius

Connecting science and delivery

Innovation, Evaluation, Education

Independence, Flexibility, Partnerships, Added Value, Scale

Independent and technology neutral

- Advisory – Scientific advice to Government and other organisations (eg gene flow studies for Defra)
- Trialling –Field and glasshouse-based evaluation of GM crops (eg BASF blight tolerant potato)
- Development –GM transformation capabilities
- Demonstration – Included in Innovation Farm (eg BASF potato, GM wheat lines, JIC purple tomato)

NIAB Innovation Farm

A Resource for the Agriculture Industry, Researchers, Opinion Formers and Policy Makers

NIAB TAG

German 'Biotech Farm'

Presentation and testing of modern products of Plant Breeding

Focusing on Biotech – GM - crops for a broad European audience. Farmers are informed and can consult on trends and products.

- ***Scientific small and large scale field trials***
- ***Sited between Hanover and Berlin***
- ***700 visitors in 2008***

Organizer / Operator: BioTech Farm GmbH & Co. KG

Partners: BASF, Monsanto (now with Pioneer & KWS)

2009


Schaugarten
Üplingen
Kartoffel
Transformation: vp60
Eigenschaft:
Produktion der Impfstoffkomponente vp60
(Antigen gegen Hämorrhagische
Kaninchenkrankheit)
Ausgangssorten: Desiree, Fasan, Albatros

NIAB Innovation Farm

- A facility to showcase role & benefits of scientific and technological innovation in agriculture & hort
- Benefiting from synergy with other initiatives
- Visitor centre for lectures and workshops and demonstration materials and posters/literature
- Field and glasshouse demonstrations
- Literature and web-based information www.innovationfarm.co.uk & interactive resources
- Links to research organisations and businesses

Cross-cutting Themes

Food Security and Quality

Climate Change

Resource Utilisation

Sustainability and Choice

Modules within Innovation Farm

Concepts will be in the form of modules, some of which will be linked

1. Plant Genetic Improvement

- History
  - Domestication of major cereals:
  - Wheat, Maize, Barley, Oats, Rye
  - Production of novel types by genetic improvement
- Plant breeding methodology
  - Classic plant breeding for yield or novel uses
  - Association genetics
  - Pre-breeding using diverse sources
  - Enhanced breeding – e,g, DH
- Introduction of New Genes
  - Wild relatives, synthetics
  - Mutation with TILLING, GM
  - Inter-specific hybrids

2. Novel use & Non food crops

- New uses for traditional crops
  - Biofuel; traditional UK crops & New crops
  - Industrial or other applications for traditional crops
  - Novel uses for crop waste products; e.g for biofuel
- Novel and Non Food crops
  - For food and non-food use including probiotics
  - Fibre, construction and industrial use
  - Biopharmaceuticals
  - Health and beauty products
  - Industrial ingredients

Exhibitor panels

Health and nutrition

Fighting malaria with plants

Innovation Farm

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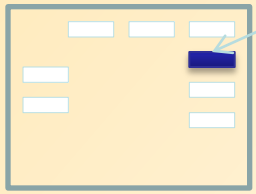

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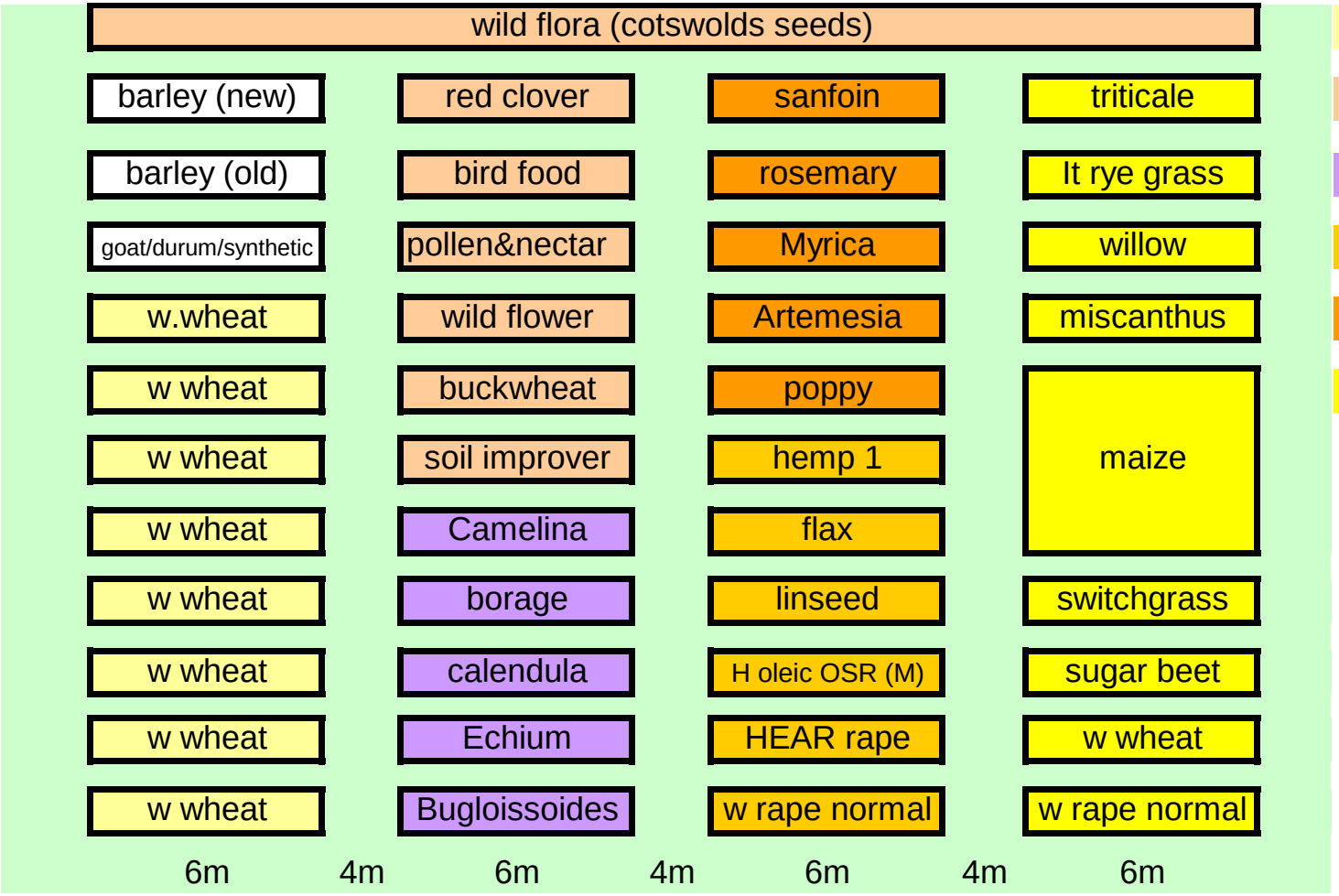
defra

www.innovationfarm.co.uk

Fieldmap showing exhibit location

Plots in 2010



History of wheat breeding

Stewardship/Environmental

Industrial Oils

Fibre & Industrial

Bio Pharmaceuticals

Dual use (Food/Bio Fuels)

August 2010 Pilot

GM Technology: glasshouse based for ease of demonstration

- JIC High anthocyanin purple tomatoes for probiotic benefits (Cathie Martin)
- BASF *P. infestans* resistant potato lines previously trialled at NIAB
- Low phytate wheat lines from NIAB for reduction of diffuse pollution

Meeting the challenge

- In the context of challenges with science and technology and especially GM, scientists must recognise the need to bring their consumers with them.
- Innovation Farm has a long term role in underpinning science messages.
- Showcase and explain public sector investment, as well as demonstrating private sector innovations.

NIAB TAG Home
Innovation Farm
Events
Contact

Innovation Farm

Through Innovation Farm NIAB is developing a living, year-round facility to showcase innovation in agriculture and horticulture focused on the challenges of:

- Food security
- Climate change
- Sustainable resources
- Health and nutrition

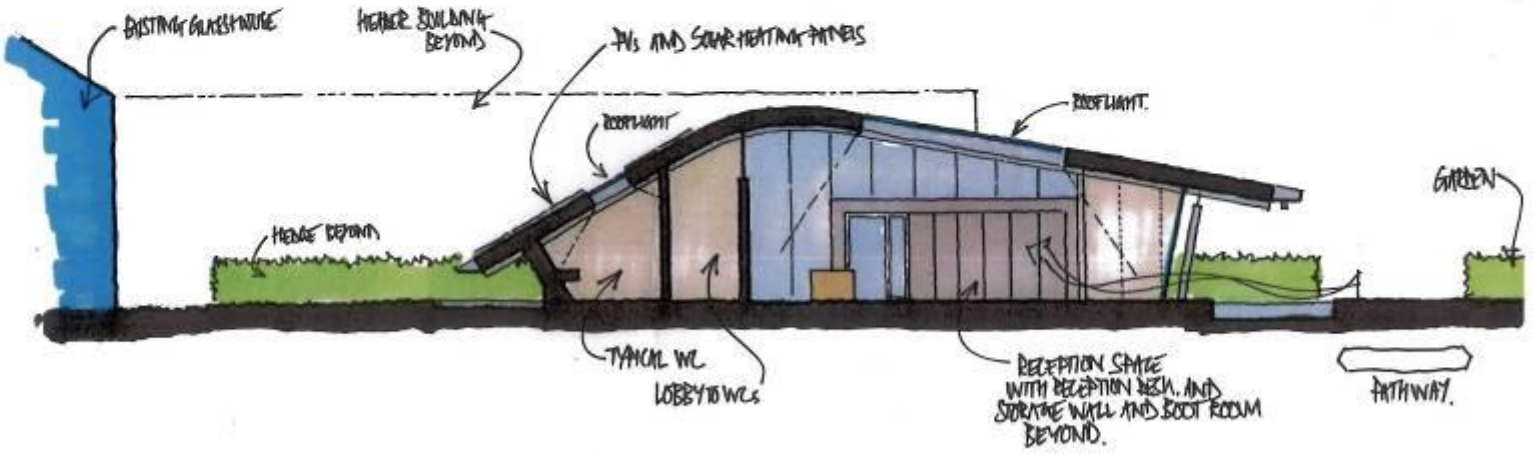
NIAB hosted the British Ecological Society Symposium:
More information

Bringing together UK researchers, businesses, students and consumers to support knowledge exchange and enable future sustainable production.

Innovation Farm provides a unique industry-wide facility to demonstrate the sustainable utilisation of plant genetic resources. It includes:

- Field and glasshouse demos

Plant Science into Practice



NIAB - PROPOSED INNOVATION FARM CROSS SECTION (SCALE APPROX 1:100) BHD ARCHITECTS 26/9/11

NIAB

Our mission: to provide impartial, science-based, research and information to support, develop and promote agriculture and horticulture; helping the industry to fulfil its potential in supplying food and renewable resources, while respecting the natural environment.

Meeting the challenges?

- UK institutions are positioned to respond
- Need increased focus of R&D resources on translation of basic science into practice (cf. Pod shatter genes in cress, wheat genome sequence)
- Need political leadership – science-based decision-making
- Need new public / private partnership models
- The Taylor Recommendations are key

Thank You

NIAB TAG